Improving Young Child Feeding in Eastern and Southern Africa

Household-Level Food Technology

Proceedings of a workshop held in Nairobi, Kenya, 12-16 October 1987
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Proceedings of a workshop held in Nairobi, Kenya, 12-16 October 1987

Editors: D. Alnwick, S. Moses, and O.G. Schmidt

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Abstract

The weaning period, that is the period in a young child's life when supplementary foods are introduced to complement breast milk, poses great nutritional risk to children in developing countries. By the end of the second year of life, one-third of children in eastern and southern Africa are chronically malnourished. The following factors contribute to the growth faltering commonly observed in weaning-age children: low nutrient intake, high incidence of diarrheal disease (often caused by contaminated weaning foods), and recent declines in duration and intensity of breastfeeding.

Food scientists, nutritionists, and health planners working in Africa and South Asia met in an international workshop to examine household-level food technologies that hold promise for improving nutrition of infants and young children. After reviewing current knowledge of breastfeeding and weaning practices in eastern and southern Africa, participants discussed the use in weaning diets of fermented foods and germinated flour, for both improved nutrient intake by young children and decreased risk of food contamination. Research that should be conducted into the effectiveness of the food technology was identified and its diffusion at the community level discussed.

This publication contains the proceedings, conclusions, and recommendations of the workshop. It is directed at scientists and health planners who are involved in nutrition research and developing programs to improve feeding of infants and young children in developing countries.

Résumé

Le sevrage, c'est-à-dire la période où l'on commence à donner des aliments solides à un jeune enfant en complément du lait maternel, présente de graves risques nutritionnels pour les enfants dans les pays en développement. Dès la fin de leur deuxième année, le tiers des enfants en Afrique orientale et australe souffrent de malnutrition chronique. Les facteurs suivants sont à l'origine du retard de croissance que l'on retrouve couramment chez les enfants en âge d'être sevrés : carence nutritionnelle, forte prévalence des maladies diarrhéiques (qui s'expliquent souvent par la contamination des aliments) et diminution récente de la durée et de l'intensité de l'allaitement maternel.

Des spécialistes des sciences de l'alimentation, des nutritionnistes et des planificateurs de la santé travaillant en Afrique et en Asie du Sud se sont réunis dans le cadre d'un atelier international afin d'examiner des technologies alimentaires applicables au niveau des ménages qui semblent prometteuses pour améliorer la nutrition des nourrissons et des jeunes enfants. Après avoir examiné les connaissances actuelles en matière d'allaitement au sein et les pratiques de sevrage en Afrique orientale et australe, les participants ont discuté de l'utilisation, au cours du sevrage, d'aliments fermentés et de farine germée, tant pour améliorer l'apport nutritionnel chez les jeunes enfants que pour diminuer les risques de contamination des aliments. Ils ont également discuté des recherches qu'il y aurait lieu d'entreprendre sur l'efficacité des technologies alimentaires et sur leur diffusion dans la collectivité.
Esta publicación contiene las actas, conclusiones y recomendaciones del taller. Está dirigida a científicos y planificadores de la salud que participan en la investigación nutricional y en programas de desarrollo para mejorar la alimentación de lactantes y niños en los países en desarrollo.
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WEANING FOOD HYGIENE IN KIAMBU, KENYA

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Abstract Food contamination has been associated with an increased intake of pathogens and with the occurrence of diarrhea in infants. A study was carried out in Kiambu District in Kenya; the objective of this study was to identify those weaning practices that carry a high risk of fecal contamination of infant food, but that could be modified by an intervention program. The presence, just before consumption, of Escherichia coli in the foods was taken as the indicator for fecal contamination. From food prepared for infants less than 1 year of age, 738 samples were collected and examined for the presence of E. coli. Methods of preparation, of storage, and of handling were also recorded. The results suggest a low level of contamination of infant foods. It is likely that this is due to appropriate food handling techniques and to the fact that most foods were cooked for relatively long periods at medium or high temperatures.

Weaning food hygiene can be defined as the handling, preparation, and storage of weaning food in such a way that the intake of pathogens by the child is decreased. Esrey et al. (1985) reviewed the literature on practices in developing countries that are associated with increased contamination. Stanton and Clemens (1987) showed an association between the frequency of handwashing before preparation of food and incidence of diarrheal disease. In a community-based study, Black et al. (1982) showed an association between food contamination with Escherichia coli and the incidence of enterotoxigenic E. coli diarrhea. Several practices were found to be associated with fecal contamination that has occurred just before the food is eaten. Barrell and Rowland (1979) found in the Gambia that the level of pathogens increased during the storage of specific food items. Black et al. (1982) found in Bangladesh that food contamination at the household level increased with higher temperatures and with longer periods of storage.

In this paper, we use fecal contamination (taking place just before consumption) as a measure for the intake of pathogens; the risk of food contamination will be identified by a measuring of the pathogenic load.
The objective of the study was to identify those weaning practices that carry a high risk of fecal contamination of infant food, but that could be modified by an intervention program. It was deemed necessary to determine

- The level of fecal contamination in common weaning foods;
- The extent to which cooking temperature and time influence fecal contamination of food; and
- The extent to which fecal contamination is influenced by the state of the utensils or by the identity of the person handling the infant food.

The study area is located 2 km from Nairobi, the capital of Kenya. It is a semi-arid rural area at an altitude of 1500-2000 m, with an annual rainfall of 600-700 mm from March to June and October to November. The population is homogeneous in terms of social structure. People live in settlement villages, each family holding between 0.5 and 1 acre (1 acre = 0.405 ha) where subsistence farming is practiced and a few animals are kept. There are no industries in the area; people work on the surrounding farms or in Nairobi. An average of six people live together in a house. The population density varies from 200 to 600/km². Water is available from one or two boreholes in each village and is distributed in donkey carts. The average use of water is 40 L in 50% of the families, 60-80 L in 40%, and 100-160 in 10%.

Methodology and Results

About 60 households were observed every other month, from September 1986 to May 1987. A fieldworker trained in observation methods remained in the house from 0700 to 1800, watching the caretaker's handling of the infant's food and drink. These observations covered preparation (cooking temperatures, duration of working, and type of ingredients), storage time, use of utensils, and identity of the person feeding the infant.

Samples were taken by the mother from food that the child had eaten at night; these samples were stored in a cool box (at around 4°C) until the following morning, when they were collected and transported between icepacks to the central laboratory in Nairobi. All samples were taken just before eating, and from the same utensil as was used for the feed. Although the 738 samples were examined for aerobic and enterobacteriaceae count (for an indication of the general level of hygiene), it was, for the purposes of this paper, the presence of E. coli that was taken as the indicator for fecal contamination.

Table 1 shows contamination of food that had been freshly prepared and that of food left over from a previous meal. Also included in the testing were "night samples": the researchers wished to determine whether the caretakers tended to be more careful in the presence of the fieldworkers. The table indicates that the percentage of contaminated infant food was relatively low (approximately 14%). When the fieldworkers were present, fresh food was prepared for the infants about two-thirds of the time; only 10.7% of the samples from
Table 1. Food samples contaminated, according to freshness and type of food (% in parentheses).

<table>
<thead>
<tr>
<th></th>
<th>E. coli present</th>
<th>E. coli absent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshly prepared</td>
<td>38 (10.7)</td>
<td>318</td>
<td>356</td>
</tr>
<tr>
<td>Leftover</td>
<td>34 (18.7)</td>
<td>148</td>
<td>182</td>
</tr>
<tr>
<td>Night sample</td>
<td>34 (17)</td>
<td>166</td>
<td>200</td>
</tr>
<tr>
<td>Total</td>
<td>106 (14.4)</td>
<td>632</td>
<td>738</td>
</tr>
</tbody>
</table>

Food type

<table>
<thead>
<tr>
<th>Food type</th>
<th>E. coli present</th>
<th>E. coli absent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tea</td>
<td>4 (20)</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>Porridge</td>
<td>12 (11.2)</td>
<td>95</td>
<td>107</td>
</tr>
<tr>
<td>Cooked cereal</td>
<td>61 (20.1)</td>
<td>242</td>
<td>303</td>
</tr>
<tr>
<td>Water</td>
<td>15 (9.8)</td>
<td>138</td>
<td>153</td>
</tr>
<tr>
<td>Milk</td>
<td>14 (10.4)</td>
<td>121</td>
<td>135</td>
</tr>
<tr>
<td>Total</td>
<td>106 (14.6)</td>
<td>612</td>
<td>718</td>
</tr>
</tbody>
</table>

these freshly prepared foods were contaminated. Contamination was found more often in samples of leftover food.

Table 1 also shows contamination according to type of food; the contamination in question occurred just before the food was consumed. Table 1 shows that among the various food items consumed, cooked cereals (the food most often used) had the heaviest contamination. Table 2 shows the various cooking temperatures and times of the food items in Table 1. Of the total number of food samples collected, about one-third were cooked for more than 1 h at temperatures of more than 70°C. Ten percent of the food samples were cooked for less than 5 min at temperatures under 30°C. About 60% of the food was cooked at moderate temperatures for a relatively long period.

Table 3 shows contamination according to cooking time and temperature. The contamination with which we are concerned here

Table 2. Number and proportion of food samples according to cooking temperature and time.

<table>
<thead>
<tr>
<th>Cooking temperature (°C)</th>
<th>≤ 30</th>
<th>31-39</th>
<th>50-69</th>
<th>70-79</th>
<th>≥ 80</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooking time (min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 5</td>
<td>64</td>
<td>51</td>
<td>69</td>
<td>18</td>
<td>41</td>
<td>243</td>
</tr>
<tr>
<td>6-15</td>
<td>4</td>
<td>23</td>
<td>29</td>
<td>15</td>
<td>36</td>
<td>107</td>
</tr>
<tr>
<td>16-30</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>15</td>
<td>35</td>
<td>57</td>
</tr>
<tr>
<td>31-59</td>
<td>0</td>
<td>1</td>
<td>9</td>
<td>18</td>
<td>75</td>
<td>103</td>
</tr>
<tr>
<td>≥ 60</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>223</td>
<td>228</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>78</td>
<td>111</td>
<td>69</td>
<td>410</td>
<td>738</td>
</tr>
</tbody>
</table>
Table 3. Food samples contaminated according to cooking temperature and time (% in parentheses).

<table>
<thead>
<tr>
<th>Cooking temperature (°C)</th>
<th>E. coli present</th>
<th>E. coli absent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 30</td>
<td>14 (20.0)</td>
<td>56</td>
<td>70</td>
</tr>
<tr>
<td>31-49</td>
<td>7 (9.0)</td>
<td>71</td>
<td>78</td>
</tr>
<tr>
<td>50-69</td>
<td>20 (18.0)</td>
<td>91</td>
<td>111</td>
</tr>
<tr>
<td>≥ 70</td>
<td>65 (13.5)</td>
<td>414</td>
<td>479</td>
</tr>
<tr>
<td>Total</td>
<td>106 (14.4)</td>
<td>632</td>
<td>738</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cooking time (min)</th>
<th>E. coli present</th>
<th>E. coli absent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 5</td>
<td>37 (15.3)</td>
<td>205</td>
<td>242</td>
</tr>
<tr>
<td>6-30</td>
<td>22 (13.6)</td>
<td>140</td>
<td>162</td>
</tr>
<tr>
<td>31-59</td>
<td>10 (9.7)</td>
<td>93</td>
<td>103</td>
</tr>
<tr>
<td>≥ 60</td>
<td>37 (16.0)</td>
<td>194</td>
<td>231</td>
</tr>
<tr>
<td>Total</td>
<td>106 (14.4)</td>
<td>632</td>
<td>738</td>
</tr>
</tbody>
</table>

Note: \( \chi^2 = 2.58, 3 \text{ df}, p = 0.46. \)

occurred immediately after preparation. Table 3 indicates that neither time nor temperature influenced the levels of contamination. It should, however, be noted that these food samples were not collected immediately after preparation, but just before the food was to be eaten; various handling procedures, such as cooling and storing, had therefore taken place.

Table 4 shows the length of time between the preparation or warming of the food and its consumption. Where an observer was present, the infant was fed almost immediately after the food was prepared (Rowland et al. 1987); this was the case over 75% of the time. About 16% of the food was eaten within 12 h of preparation. Only 5% was eaten over a further 12-h period. We see, therefore, that although this food becomes more contaminated the longer it is stored, the quantities of food stored for long periods are fortunately very small.

Table 4. Food samples contaminated according to duration of storage (% in parentheses).

<table>
<thead>
<tr>
<th>Duration of storage</th>
<th>E. coli present</th>
<th>E. coli absent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eaten immediately</td>
<td>53 (12.6)</td>
<td>367</td>
<td>420</td>
</tr>
<tr>
<td>&lt;12 hours</td>
<td>14 (15.9)</td>
<td>74</td>
<td>88</td>
</tr>
<tr>
<td>&gt;12 hours</td>
<td>5 (17.9)</td>
<td>23</td>
<td>28</td>
</tr>
<tr>
<td>Night sample</td>
<td>34 (16.8)</td>
<td>168</td>
<td>202</td>
</tr>
<tr>
<td>Total</td>
<td>106 (14.4)</td>
<td>632</td>
<td>738</td>
</tr>
</tbody>
</table>

Note: \( \chi^2 = 2.49, 3 \text{ df}, p = 0.48. \)
Table 5. Food samples contaminated according to method of feeding (% in parentheses).

<table>
<thead>
<tr>
<th>Method of feeding</th>
<th>E. coli present</th>
<th>E. coli absent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottle</td>
<td>12 (14.1)</td>
<td>73</td>
<td>85</td>
</tr>
<tr>
<td>Cup and spoon</td>
<td>53 (12.8)</td>
<td>361</td>
<td>414</td>
</tr>
<tr>
<td>Hands</td>
<td>7 (18.4)</td>
<td>31</td>
<td>38</td>
</tr>
<tr>
<td>Night sample</td>
<td>34 (16.9)</td>
<td>167</td>
<td>201</td>
</tr>
<tr>
<td>Total</td>
<td>106 (14.4)</td>
<td>632</td>
<td>738</td>
</tr>
</tbody>
</table>

Note: $x^2 = 2.39$, 2 df, $p = 0.49$.

Table 6. Food samples contaminated according to identity of person feeding the infant (% in parentheses).

<table>
<thead>
<tr>
<th>Person feeding</th>
<th>E. coli present</th>
<th>E. coli absent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother</td>
<td>57 (13.2)</td>
<td>374</td>
<td>431</td>
</tr>
<tr>
<td>Other</td>
<td>15 (14.2)</td>
<td>91</td>
<td>106</td>
</tr>
<tr>
<td>Night sample</td>
<td>34 (16.9)</td>
<td>167</td>
<td>201</td>
</tr>
<tr>
<td>Total</td>
<td>106 (14.4)</td>
<td>632</td>
<td>738</td>
</tr>
</tbody>
</table>

Note: $x^2 = 3.59$, 2df, $p = 0.16$.

Table 5 shows contamination according to method of feeding. It must be noted that the food was served in the utensils but not stored in them. Excluding the night samples, taken when no observer was present, about 75% of the infants were fed from a cup and spoon, 16% bottle fed, and another 7% hand fed.

Table 6 shows contamination according to identity of the person feeding the infant. We see that in most cases (about 75% of the time during the observation period), it was the mothers who fed their infants. Approximately the same number of samples were collected from feeds given by the mother as from those given by other people ($p = 0.16$); in the latter instances, however, the levels of contamination are noticeably higher.

Conclusions

The study showed that levels of contamination of infant foods are relatively low in Kiambu District. This could be due to the following factors: over 75% of the time, the food is eaten almost immediately after being prepared; during the weaning period, mothers take direct responsibility for feeding their infants; and in most cases, the food is cooked for relatively long periods, at medium or high temperatures. (This has been said by food hygienists to reduce the inoculation dose.) Sampling of the food immediately after cooking
will therefore give different results, depending on cooking time and temperature.

Where higher levels of contamination were in evidence, the study shows that the handling of the food after preparation had had some influence: it was observed, for example, that when food was cooked at high temperatures, the mothers would add either cold milk or leftovers to cool it - a process that could have led to contamination. Of all the weaning foods, cooked cereals were most often used and were most often contaminated. It should be mentioned, however, that a diarrhea surveillance survey conducted in this district showed that the incidence of diarrhea was 0.54 attacks/child per year among infants under 6 months of age, and 1.66 among children aged 6 months to 1 year; these rates appear very low when compared with those in other parts of Kenya.

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